Remarks

Rejections under 35 U.S.C. § 112

Claim 3 stands rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to further limit claim 1. Claim 3 has been amended as discussed below and is now an independent claim, thus rendering the rejection moot. Withdrawal of the rejection is respectfully requested.

Claims 42-44 stand rejected under 35 U.S.C. § 112, second paragraph, as being vague in that it is unclear how the components of the device in these claims are related to the components of the device in claim 1. Claim 42 has been amended to recite that the flux circulator is disposed around the magnetic regions. Support for the amendment is found in Figure 14 and in the description at p. 30, lines 4-12. Claim 43 has been amended to recite that the photodetectors are located in proximity to locations for trapping the magnetic particles so as to detect an optical signal from trapped particles. Support for the amendment is found at p. 40, line 17-20. Claim 44 has been amended to recite that the microfluidic assembly comprises channels positioned so as to allow introduction of fluids to the magnetic regions via the channels. Support for the amendment is found at p. 38, line 13-14; p. 38, line 24 - p. 39, line 8.

Rejections under 35 U.S.C. § 102

Claims 1-10, 12, 14, 15, 21-23, 26-30, 32, 35-36, 38-41, 59, 61-63, and 65-68 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Baglin, et al., U.S. Pat. No. 6,440,520, hereinafter "Baglin". The Examiner states that since the substrate of Baglin is the same as the substrate of original claim 1, it would function like the claimed device. While not agreeing with the Examiner's position, claim 1 has been amended to recite features of certain embodiments of the instant invention, which clearly distinguish it from the device of Baglin. Claim 1 as amended recites that the magnetic regions have gaps between them and have a maximum length and a maximum width, with the maximum length being greater than the maximum width, and wherein the magnetic regions produce a plurality of localized magnetic fields when magnetized, and wherein the localized magnetic fields are sufficient to trap a magnetic particle between the magnetic regions. Support for the amendment reciting that the magnetic regions have gaps between them is found throughout the specification, e.g., at p.21, lines 4-5. Support for the

amendment reciting the relationship between the maximum length and width is found at p. 24, line 24 – p. 25, line 14. Support for the amendment reciting that the localized magnetic fields are sufficient to trap a particle between the regions is found throughout the specification, e.g., at p.21, lines 4-5 and 11-12. The magnetic regions of Baglin have a circular cross-section and therefore do not have a maximum length and width, with the maximum length being greater than the maximum width as recited in amended claim 1. Furthermore, since the magnetic regions of Baglin are symmetric about their axis, one of ordinary skill in the art would immediately recognize that the regions of Baglin would not produce forces that would trap a magnetic particle between the regions as recited in amended claim 1. Claim 1 has also been amended to replace the word "five" by "three". Support is found in original claim 3.

Claim 3, which was originally dependent on claim 1, has been rewritten in independent form and now recites that the magnetic regions have a maximum length and a maximum width, wherein a plurality of regions are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, so that the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width. Support for the amendment is found in Figures 2, 3, and 11, all of which clearly show embodiments in which the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width. The magnetic regions of Baglin have a circular cross-section and therefore do not have a maximum length and width, with the length being greater than the width as recited in amended claim 3. Furthermore, as noted in reference to amended claim 1, since the magnetic regions of Baglin are symmetric about their axis, one of ordinary skill in the art would immediately recognize that the regions of Baglin would not produce forces that would trap a magnetic particle between the regions as recited in amended claim 3.

Claim 5, which was originally dependent on claim 1, has been rewritten in independent form and now recites that the magnetic regions are appropriately shaped and have an appropriate size so as to generate localized magnetic fields that exist substantially in a volume between adjacent north and south poles of adjacent magnetic regions above the upper surface of the device and wherein the magnetic fields are sufficient to trap a magnetic particle with a trapping energy at least three times greater than the thermal energy of the particle at room temperature. Support for the amendment is found throughout the specification, e.g., at p. 21, lines 8-10, p. 23,

lines 10-17, in Figs. 1-4 and p. 35, lines 3-17 (discussing decay of the field outside the volume between adjacent magnetic regions). Support for the recitation of "at least three times greater…" is found in original claim 3.

Claim 59 has been amended to recite a substrate comprising a plurality of magnetic regions, wherein the localized magnetic regions produce a plurality of localized magnetic fields concentrated in gaps between the regions, and wherein the magnetic regions project above the surface of the substrate and have a maximum length and a maximum width, with the maximum length being greater than the maximum width, wherein a plurality of regions are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, and wherein the distance separating adjacent regions in the dimension of the length is less than the distance separating adjacent regions in the dimension of the width. Support for the aspect of the claim reciting that the fields are concentrated in gaps between the regions is found throughout the specification, e.g., at p. 23, lines 10-17, in Fig. 3, and at p. 35, lines 3-17. Support for the amendment reciting the relationship between the maximum length and width is found at p. 24, line 24 – p. 25, line 14. Support for the aspect of the claim reciting that the fields are concentrated in the gap is found throughout the specification, e.g., at p. 23, lines 10-17, in Fig. 3, and at p. 35, lines 3-17. Support for the amendment reciting that a plurality of regions are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, so that the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width is found in Figures 2, 3, and 11, all of which clearly show embodiments in which the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width.

Claims 2, 4, 7-10, 12, 15, 21-23, 26-30, 32, 35-36, and 38-41, 61-63, and 65-67 are dependent on claims 1, 3, 5, and/or 59. Claims 6, 14, and 68 have been canceled. Since the amendments to claims 1, 3, 5, and 59 clearly distinguish the claimed invention from the device of Baglin, withdrawal of the rejection is respectfully requested.

Claims 1-6, 10-12, 14, 15, 21-23, 26, 33, 34, 35, 38-41, 45, 46, 49, and 54-58 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Gombinsky, et al., U.S. Pat. No. 5,395,498, hereinafter "Gombinsky". The Examiner states that the matrix of Gombinsky is the

same as the substrate of claim 1 since "Magnets arranged in a desired pattern (magnetic layer) can be used to immobilize magnetic particles to the matrix." While Applicants disagree with the Examiner's assertion that the matrix of Gombinsky is the same as the substrate of original claim 1 and would function like the device of original claim 1, the instant amendments clearly distinguish over Gombinsky. In particular, Gombinsky does not teach a device comprising a plurality of magnetic regions having gaps between them, wherein the magnetic regions produce a plurality of localized magnetic fields when magnetized, and wherein the localized magnetic fields are sufficient to trap a magnetic particle between the magnetic regions as recited in amended claim 1. Gombinsky teaches arrangements comprising a plurality of magnets and that such magnets can be used to either prepare a matrix comprising magnetic particles or to facilitate the collection magnetic particles from a matrix. However, the embodiments taught by Gombinsky do not capture magnetic particles in gaps between the magnets as in amended claim 1 but rather above the magnetic layer, either in a gel above the magnets (Example I of Gombinksy) or on a net above the magnets (Example III of Gombinsky). Furthermore, in the arrangement taught in Example I of Gombinsky, the magnets are separated by rubber strips rather than by gaps as in claim 1. Note that the instant application clearly indicates that a gap must be able to accommodate a bead and thus cannot be filled with rubber. In the arrangement taught in Example III of Gombinsky, there are only two magnetic regions, since the magnets are placed in two pairs, which would be insufficient to produce a *plurality* of localized magnetic fields. It is clear that Gombinsky is describing two magnetic regions since he refers to "the gap" rather than to "gaps" between the regions. The two magnetic regions are simply used to hold the particles as a group in place, while they are collected from individual locations using a separate electromagnet.

Gombinsky also does not teach the device of claim 3, which recites that the magnetic regions have a maximum length and a maximum width, wherein a plurality of regions are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, so that the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width. Gombinsky teaches either strips of magnets in which the magnets are not spaced apart in both dimensions or a set of two pairs of magnets in which there are only two magnetic regions rather than a plurality of regions spaced apart in two dimensions.

Gombinsky also does not teach the device of amended claim 5. In particular, Gombinsky does not teach a device comprising a plurality of magnetic regions having gaps between them, as explained above, and does not teach magnetic regions that are appropriately shaped and have an appropriate size so as to generate localized magnetic fields that exist substantially in a volume between adjacent north and south poles of adjacent magnetic regions.

In summary, since Gombinsky does not teach the invention of claims 1, 3, or 5, as amended, Applicants respectfully request withdrawal of the rejection of these claims and of the claims dependent therefrom. Applicants further note that Gombinsky does not teach a device in which magnetic material regions are arranged in a pattern of mutually perpendicular rows and columns as in original claim 10 and does not teach an array of subarrays configuration as in original claim 11. Gombinsky also does not teach a device in which adjacent magnetic regions are separated by a gap approximately equal in size to the size of a magnetic particle as in original claims 21-23. Gombinsy also does not teach a device wherein adjacent magnetic regions are separated by a gap having a greatest dimension approximately equal in size to the greatest dimension of a magnetic particle, wherein the magnetic particle is substantially spherical, and the greatest dimension of the particle is the diameter of the particle as in original claim 26.

Claims 1-13, 15, 22, 23, 26, 30-36, 38-41, 45-47, and 59-68 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Zhou, et al., U.S. Pat. No. 6,355,491, hereinafter "Zhou". The Examiner asserts that the substrate of Zhou is the same as the substrate of claim 1. While Applicants disagree with the Examiner's assertion that the substrate of Zhou is the same as the substrate of original claim 1 and would function like the claimed device, the instant amendments clearly distinguish over Zhou for at least the following two reasons.

Firstly, Zhou does not teach a device wherein magnetic particles are trapped between the magnetic regions as recited in amended claim 1. Instead, Zhou teaches that magnetic particles are trapped on a "functional layer" that is located above the microelectromagnetic units. For example, Zhou describes that "The precise site of immobilization on the functional layer 42 is controlled by the magnetic fields generated by the electromagnetic units. That is, in most cases the ligand will be immobilized *immediately above a unit* if a single electromagnetic core 26 is magnetized." (col. 15, lines 47-53) (emphasis added). Zhou also teaches that "For immobilizing ligand molecules, the magnetic field generated by energized magnetic units will exert magnetic forces on the paramagnetic microbead 56 that will bring the overall molecular assembly into

contact with the *surface of the biochip above the energized electromagnetic unit*." (col. 17, lines 24-28) (emphasis added).

Secondly, Zhou does not teach a device comprising a plurality of magnetic regions having gaps between them, wherein the magnetic regions have a maximum length and a maximum width, with the maximum length being greater than the maximum width. Instead, Zhou teaches that "electromagnetic units may take the form of loops of electric conductive traces...around a core...The loops may be of a number of geometrical shapes such as circle, spiral, square, and squared-spiral." (col. 9, lines 49-54). Shapes such as these do not have a maximum length and a maximum width with the maximum length being greater than the maximum width.

With respect to claim 3, Zhou does not teach a device wherein the magnetic regions have a maximum length and a maximum width, and wherein a plurality of regions are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, so that the distance separating adjacent regions in the dimension of the maximum length is less than the distance separating adjacent regions in the dimension of the maximum width as recited in amended claim 3. Zhou does not contain any teachings related to the relative spacing of the microelectromagnetic units with respect to one another.

With respect to claim 5, Zhou does not teach a device wherein the magnetic regions are appropriately shaped and have an appropriate size so as to generate localized magnetic fields that exist substantially in a volume between adjacent north and south poles of adjacent magnetic regions above the upper surface of the device. The north and south poles of the magnetic regions of Zhou would exist substantially between north and south poles of each individual unit and would be perpendicular to the plane of the substrate, rather than existing substantially between adjacent units. Furthermore, the magnetic regions of Zhou are located beneath the surface of Zhou's device (see Fig. 4) and even if magnetic fields did extend between adjacent magnetic regions, they would not exist in a volume between the regions above the upper surface of the device since any fields existing substantially in a volume between the regions would be beneath the surface of the device.

With respect to claim 59, Zhou does not teach a device wherein the magnetic regions project above the surface of the substrate and have a maximum length and a maximum width, with the maximum length being greater than the maximum width, wherein a plurality of regions

are spaced apart along the dimension of the maximum length and a plurality of regions are spaced apart along the dimension of the maximum width, and wherein the distance separating adjacent regions in the dimension of the length is less than the distance separating adjacent regions in the dimension of the width.

The additional claims rejected as being anticipated by Zhou are dependent on claims 1, 3, 5, and/or 59. Since the amendments to claims 1, 3, 5, and 59 clearly distinguish over Zhou, withdrawal of the rejection of claims 1, 3, 5, 59 and claims dependent therefrom is respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhou. While not agreeing that it would have been obvious to modify the device of Zhou to arrive at a device in which the number of magnetic regions is at least 1000; 10,000; 100,000; 250,000; or 1,000,000 per centimeter squared, Applicants respectfully submit that even had it been obvious to modify the originally claimed device as suggested by the Examiner, since the instant amendments clearly distinguish the claimed device from that of Zhou, the rejection for obviousness should be withdrawn.

New claims

New claim 113 recites the device of claim 1, 3, or 59, wherein the magnetic regions have a maximum length that is between 3 and 5 times as great as the maximum width or between 5 and 10 times as great as the maximum width. Support for this claim is found at p. 25, lines 1-5.

New claim 114 recites the device of claim 1, 3, or 59, wherein adjacent magnetic regions are separated by a gap of between 1 and 5 microns or between 5 and 15 microns. Support is found at p. 26, lines 20-24.

New claim 115 recites the device of claim 1, 3, or 59, wherein the magnetic regions are not rectangular. Support is found at p. 25, line 7, referring to embodiments of the invention in which the islands are not rectangular, and elsewhere in the specification.

New claim 116 and 117 recite a device for forming an array of magnetic particles, the device comprising: a substrate comprising a plurality of magnetic regions, wherein the magnetic regions have a maximum length and a maximum width, with the maximum length being greater than the maximum width, wherein the magnetic regions produce a plurality of localized magnetic

fields when magnetized, and wherein the magnetic regions are not rectangular. Support is found as described above for the amendment to claim 1, at p. 25, line 7, referring to embodiments of the invention in which the islands are not rectangular, and elsewhere in the specification. The device of claim 117 recites that the localized magnetic fields are sufficient to trap a magnetic particle between the magnetic regions with a trapping energy at least three times greater than the thermal energy of the particle at room temperature. Support is found in original claim 3.

New claim 118 recites the device of claim 116, wherein the magnetic regions project above the surface of the substrate. Support for the claim is found in original claim 7.

New claim 119 recites the device of claim 1, wherein the size, shape, and spacing of the regions are selected to increase the likelihood of trapping only a single magnetic particle within the gaps. Support is found throughout the specification, in particular at p. 26, lines 9-12.

New claim 120 recites the device of claim 1, wherein the distance between the ends of adjacent magnetic regions in the dimension of the maximum length is 200 microns or less. Support is found at p. 11, lines 21-22, reciting that particles generally have a largest dimension of less than approximately 200 microns, and at p. 26, lines 26-29, reciting that in certain embodiments of the invention the maximum dimension of the gap is approximately equal to the maximum dimension of a magnetic particle.

New claim 121 recites a device for forming an array of magnetic particles, the device comprising: a substrate comprising a plurality of magnetic regions, wherein the localized magnetic regions produce a plurality of localized magnetic fields concentrated in gaps between the regions, and wherein the magnetic regions project above the surface of the substrate and have a maximum length and a maximum width, with the maximum length being greater than the maximum width by a factor of at least 5. Support for this claim is found in original claims 1 and 7, at p. 25, lines 1-6, at p. 23, lines 10-17, and in Figures 3 and 11.

The Examiner indicated that claim 37 was free of prior art. New claim 122 is the same as original claim 37 but is written in independent form.

The Examiner indicated that claim 43 was free of prior art, but the claim was rejected as being vague. New claim 123 is the same as original claim 43 but is written in independent form and also recites that the photodetectors are located in proximity to locations for trapping the magnetic particles so as to detect an optical signal from trapped particles to address the rejection of original claim 43. Support is found at p. 40, line 17-20.

The Examiner indicated that claim 44 was free of prior art, but the claim was rejected as being vague. New claim 124 is the same as original claim 44 but is written in independent form and also recites that the microfluidic assembly comprises channels positioned so as to allow introduction of fluids to the magnetic regions via the channels. Support is found at p. 38, line 13-14; p. 38, line 24 - p. 39, line 8.

In conclusion, in view of the amendments and remarks presented herein, the application and pending claims comply with the requirements of 35 U.S.C. §112, 35 U.S.C. §102, and 35 U.S.C. §103. Applicants therefore respectfully submit that the present case is in condition for allowance. A Notice to that effect is respectfully requested.

If, at any time, it appears that a phone discussion would be helpful in resolving any remaining issues, the undersigned would greatly appreciate the opportunity to discuss such issues at the Examiner's convenience. The undersigned can be contacted at (617) 248-5000 or (617) 248-5071 (direct dial).

A check in the amount of $60.00 to cover the fee for a one (1) month extension of time is enclosed. Please charge any additional fees associated with this filing, or apply any credits, to our Deposit Account No. 03-1721.

Respectfully submitted,

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